PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
E15110 Re/AN		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/NO00/00260	09.08.2000	10.08.1999
International Patent Classification (IPC) or national classification and IPC7		
B 23 P 15/14		
Applicant		
Engineering & Drilling Machinery AS et al		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 3 sheets, including this cover sheet.

☒ This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 1 sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☐ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
20.02.2001	16.11.2001
Name and mailing address of the IPEA/SE	Authorized officer
Patent- och registreringsverket Box 5055 S-102 42 STOCKHOLM Facsimile No. 08-667 72 88	Telex 17978 PATOREG-S Åsa Lööf/ELY Telephone No. 08-782 25 00

Form PCT/IPEA/409 (cover sheet) (January 1998)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

national application No.
PCT/NO00/00260

I. Basis of the report

1. With regard to the **elements** of the international application:*

☐ the international application as originally filed

☒ the description:
pages 1-3 , as originally filed
pages _____ , filed with the demand
pages _____ , filed with the letter of _____

☒ the claims:
pages _____ , as originally filed
pages _____ , as amended (together with any statement) under article 19
pages _____ , filed with the demand
pages 5 , filed with the letter of 01.08.2001

☒ the drawings:
pages 1-2 , as originally filed
pages _____ , filed with the demand
pages _____ , filed with the letter of _____

☐ the sequence listing part of the description:
pages _____ , as originally filed
pages _____ , filed with the demand
pages _____ , filed with the letter of _____

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.
These elements were available or furnished to this Authority in the following language English which is:

☐ the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).

☒ the language of publication of the international application (under Rule 48.3(b)).

☐ the language of the translation furnished for the purposes of international preliminary examination (under Rules 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

☐ contained in the international application in written form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. ☐ The amendments have resulted in the cancellation of:

☐ the description, pages _____

☐ the claims, Nos. _____

☐ the drawings, sheet/fig _____

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2 (c)).**

* *Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).*

** *Any replacement sheet containing such amendments must be referred to under item I and annexed to this report.*

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.
PCT/NO00/00260

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	1-5	YES
	Claims		NO
Inventive step (IS)	Claims	1-5	YES
	Claims		NO
Industrial applicability (IA)	Claims	1-5	YES
	Claims		NO

2. Citations and explanations (Rule 70.7)

Cited documents:

1. DE 3831627 A1 (Bursig, Ernest)
2. DE 19737111 A1 (Asea Brown Boveri AG.)

The documents cited in the International Search Report represent background art.

The invention defined in claims 1-5 is not disclosed by any of these documents.

None of the cited documents gives any indication towards the claimed gear wheel and the method of strengthening it. No relevant combination of the cited documents would lead a person skilled in the art to the invention defined in the claims.

Therefore, the invention defined in claims 1-5 is novel and is considered to involve an inventive step. It is also considered to be industrially applicable.

AMENDED CLAIMS

1.

A method for strengthening a gear wheel (1), wherein strengthening rings (3,4) are placed around the gear wheel and connected to the gear wheel teeth (2), **characterised in** that each tooth (2) is fixed like a theoretical beam between two extreme points in that two strengthening wheels (3, 4), each shaped on its inside in conformity with the gear wheel teeth (2), are shrink-fitted around the gear wheel.

2.

A method according to claim 1, **characterised in** that the strengthening rings (3, 4) are shrink-fitted around the gear wheel (1) in such manner that the strengthening rings (3, 4) will be firmly shrunk onto the gear wheel (1) with a material-technical tensile/-compressive strength within 80% of the 0.2% elastic elongation range of the material (steel).

3.

A method according to claim 2, **characterised in** that during the sizing process the toothed rim of the driving gear (1) is envisaged stretched out to a correspondingly larger circle, shrink fits being selected for this circle in accordance with the ISO tables of limits and fits, and that similar considerations are made for each strengthening ring (3, 4).

4.

A gear wheel (1) having surrounding strengthening rings (3,4) connected to the gear wheel teeth (2), **characterised in** that each tooth (2) is fixed like a theoretical beam between two extreme points in that two strengthening rings (3, 4), shaped on their insides in conformity with the gear wheel teeth (2), are shrink-fitted around the gear wheel.

5.

A gear wheel according to claim 4, **characterised in** that the strengthening rings (3, 4) are shrink-fitted in such manner that the strengthening rings (3, 4) will be firmly shrunk onto the gear wheel (1) with a material-technical tensile/compressive strength within 80% of the 0.2% elastic elongation range of the material (steel).

PATENT COOPERATION TREATY

12 JULI 2001

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:

BRYNS PATENTKONTOR A/S
P.O. Box 765, Sentrum
N-0106 OSLO, NORWAY

PCT

WRITTEN OPINION

(PCT Rule 66)

Date of mailing *(day/month/year)*	10-07-2001
Applicant's or agent's file reference: E15110 Re/AN	**REPLY DUE** within 60 days from the above date of mailing
International application No.: PCT/NO00/00260	International filing date *(day/month/year)*: 09.08.2000
	Priority date *(day/month/year)*: 10.08.1999
International Patent Classification (IPC) or both national classification and IPC7: B23P 15/14	
Applicant: Engineering & Drilling Machinery AS et al	

1. This written opinion is the first (first, etc.) drawn by this International Preliminary Examining Authority.
2. This opinion contains indications relating to the following items:
   - I ☒ Basis of the report
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   - VI ☐ Certain documents cited
   - VII ☐ Certain defects in the international application
   - VIII ☐ Certain observations on the international application
3. The applicant is hereby **invited to reply** to this opinion.
   When? See the time limit indicated above. The applicant may, before the expiration of that time limit, request this Authority to grant an extension, see Rule 66.2(d).
   How? By submitting a written reply, accompanied, where appropriate, by amendments, according to Rule 66.3. For the form and the language of the amendments, see Rules 66.8 and 66.9.
   Also For an additional opportunity to submit amendments, see Rule 66.4. For the examiner's obligation to consider amendments and/or arguments, see Rule 66.4*bis*. For an informal communication with the examiner, see Rule 66.6.
   If no reply is filed, the international preliminary examination report will be established on the basis of this opinion.
4. The final date by which the international preliminary examination report must be established according to Rule 69.2 is: 10.12.2001

Name and mailing address of the IPEA/SE
Patent- och registreringsverket
Box 5055
S-102 42 STOCKHOLM
Telex 17978 PATOREG-S
Facsimile No. 08-667 72 88

Authorized officer
Anders Brinkman/MP
Telephone No. 08-782 25 00

WRITTEN OPINION

International application No.
PCT/NO00/00260

I. Basis of the opinion

1. With regard to the **elements** of the international application:*

☒ the international application as originally filed

☐ the description:
pages _____, as originally filed
pages _____, filed with the demand
pages _____, filed with the letter of _____

☐ the claims:
pages _____, as originally filed
pages _____, as amended (together with any statement) under article 19
pages _____, filed with the demand
pages _____, filed with the letter of _____

☐ the drawings:
pages _____, as originally filed
pages _____, filed with the demand
pages _____, filed with the letter of _____

☐ the sequence listing part of the description:
pages _____, as originally filed
pages _____, filed with the demand
pages _____, filed with the letter of _____

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.
These elements were available or furnished to this Authority in the following language English which is:

☐ the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).

☒ the language of publication of the international application (under Rule 48.3(b)).

☐ the language of the translation furnished for the purposes of international preliminary examination (under Rules 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the written opinion was drawn on the basis of the sequence listing:

☐ contained in the international application in printed form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. ☐ The amendments have resulted in the cancellation of:

☐ the description, pages _____

☐ the claims, Nos. _____

☐ the drawings, sheet/fig _____

5. ☐ This opinion has been drawn as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2 (c)).

* *Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this opinion as "originally filed".*

WRITTEN OPINION

International application No.
PCT/NO00/00260

V. Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	2,3,5	YES
	Claims	1,4	NO
Inventive step (IS)	Claims		YES
	Claims	1-5	NO
Industrial applicability (IA)	Claims	1-5	YES
	Claims		NO

2. Citations and explanations

The invention relates to a method and a device for strengthening metal drive gears. The solution to the problem according to the invention is to reinforce the two outer sides of the drive gear with receiving metal rings.

Claims 1 and 4

DE, A1, 3831627 discloses a method and a device for making a drive gear more rigid by using surrounding strengthening metal rings, which fix the teeth between the restraining rings. The invention according to claim 1 and 4 is thus not novel (refer to column 2, lines 7-12 and fig.1).

Claims 2, 3 and 5

The invention according to claims 2, 3 and 5 differs from the method in D1 in that the strengthening rings are shrunk onto the gear wheel. The problem, which a person skilled in the art faces, is to provide an alternative fastening arrangement between the rings and the gears. The technical field of metal shrink fittings is previously known, as well as the characteristics of steel. It is therefore considered obvious for a person skilled in the art to assemble the device in D1 with a shrink fitting. To restrict the tensile/compressive strength within 80% of the 0.2% elastic elongation as well as selecting values from the ISO tables is also considered obvious to a person skilled in the art.

The invention according to claims 2, 3 and 5 is therefore not considered to involve an inventive step.

PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION CONCERNING SUBMISSION OR TRANSMITTAL OF PRIORITY DOCUMENT

(PCT Administrative Instructions, Section 411)

To:

REISTAD, Gunnar, O.
Bryns Patentkontor A/S
P.O. Box 765, Sentrum
N-0106 Oslo
NORVÈGE

Date of mailing (day/month/year) 26 September 2000 (26.09.00)	
Applicant's or agent's file reference E15110 Re/AN	**IMPORTANT NOTIFICATION**
International application No. PCT/NO00/00260	International filing date (day/month/year) 09 August 2000 (09.08.00)
International publication date (day/month/year) Not yet published	Priority date (day/month/year) 10 August 1999 (10.08.99)
Applicant ENGINEERING & DRILLING MACHINERY AS et al	

1. The applicant is hereby notified of the date of receipt (except where the letters "NR" appear in the right-hand column) by the International Bureau of the priority document(s) relating to the earlier application(s) indicated below. Unless otherwise indicated by an asterisk appearing next to a date of receipt, or by the letters "NR", in the right-hand column, the priority document concerned was submitted or transmitted to the International Bureau in compliance with Rule 17.1(a) or (b).

2. This updates and replaces any previously issued notification concerning submission or transmittal of priority documents.

3. An **asterisk(*)** appearing next to a date of receipt, in the right-hand column, denotes a priority document submitted or transmitted to the International Bureau but not in compliance with Rule 17.1(a) or (b). In such a case, **the attention of the applicant is directed** to Rule 17.1(c) which provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.

4. The **letters "NR"** appearing in the right-hand column denote a priority document which was not received by the International Bureau or which the applicant did not request the receiving Office to prepare and transmit to the International Bureau, as provided by Rule 17.1(a) or (b), respectively. In such a case, **the attention of the applicant is directed** to Rule 17.1(c) which provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.

Priority date	Priority application No.	Country or regional Office or PCT receiving Office	Date of receipt of priority document
10 Augu 1999 (10.08.99)	19993835	NO	28 Augu 2000 (28.08.00)

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No. (41-22) 740.14.35

Authorized officer

Catherine Massetti

Telephone No. (41-22) 338.83.38

PATENT COOPERATION TREATY

22 FEB. 2001

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

PCT

To:

Reistad, Gunnar O. Bryns
Patentkontor a/s
P.O.Box 765
N-0106 Oslo

NOTIFICATION OF RECEIPT
OF DEMAND BY COMPETENT INTERNATIONAL
PRELIMINARY EXAMINING AUTHORITY

(PCT Rules 59.3(e) and 61.1(b), first sentence
and Administrative Instructions, Section 601(a))

Date of mailing *(day/month/year)*	20 -02- 2001

Applicant's or agent's file reference	IMPORTANT NOTIFICATION
E15110 Re/AN	

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/NO00/00260	09-08-2000	10-08-1999

Applicant
Enfineering & Drilling Machinery AS
et al

1. The applicant is hereby **notified** that this International Preliminary Examining Authority considers the following date as the date of receipt of the demand for international preliminary examination of the international application:

   20-02-2001

2. This date of receipt is:

   [X] the actual date of receipt of the demand by this Authority (Rule 61.1(b)).

   [ ] the actual date of receipt of the demand on behalf of this Authority (Rule 59.3(e)).

   [ ] the date on which this Authority has, in response to the invitation to correct defects in the demand (Form PCT/IPEA/404), received the required corrections.

3. [ ] **ATTENTION:** That date of receipt is **AFTER** the expiration of 19 months from the priority date. Consequently, the election(s) made in the demand does (do) not have the effect of postponing the entry into the national phase until 30 months from the priority date (or later in some Offices) (Article 39(1)). Therefore, the acts for entry into the national phase must be performed within 20 months from the priority date (or later in some Offices) (Article 22). For details, see the *PCT Applicant's Guide*, Volume II.

   [ ] *(If applicable)* This notificaton confirms the information given by telephone, facsimile transmission or in person on:

4. Only where paragraph 3 applies, a copy of this notification has been sent to the International Bureau.

Name and mailing address of the IPEA/	Authorized officer
Patent- och registreringsverket Box 5055 S-102 42 STOCKHOLM Facsimile No. 08-667 72 88 Telex 17978 PATOREG-S	Telephone No. 08-782 25 00 Jan-Erik Karlsson

Form PCT/IPEA/402 (July 1998)

PATENT COOPERATION TREATY

PCT

NOTIFICATION OF THE RECORDING OF A CHANGE

(PCT Rule 92bis.1 and Administrative Instructions, Section 422)

From the INTERNATIONAL BUREAU

To:

REISTAD, Gunnar, O.
Bryns Patentkontor A/S
P.O. Box 765, Sentrum
N-0106 Oslo
NORVÈGE

Date of mailing (day/month/year)
21 février 2002 (21.02.02)

Applicant's or agent's file reference
E15110 Re/AN

IMPORTANT NOTIFICATION

International application No.
PCT/NO00/00260

International filing date (day/month/year)
09 août 2000 (09.08.00)

1. The following indications appeared on record concerning:

[X] the applicant [ ] the inventor [ ] the agent [ ] the common representative

Name and Address
ENGINEERING & DRILLING MACHINERY AS
Maskinveien 12
N-4033 Stavanger
Norway

State of Nationality: NO
State of Residence: NO
Telephone No.:
Facsimile No.:
Teleprinter No.:

2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

[ ] the person [ ] the name [X] the address [ ] the nationality [ ] the residence

Name and Address
ENGINEERING & DRILLING MACHINERY AS
Herikstadveien 25
N-4349 Bryne
Norway

State of Nationality: NO
State of Residence: NO
Telephone No.:
Facsimile No.:
Teleprinter No.:

3. Further observations, if necessary:

4. A copy of this notification has been sent to:

[X] the receiving Office
[ ] the International Searching Authority
[ ] the International Preliminary Examining Authority
[ ] the designated Offices concerned
[X] the elected Offices concerned
[ ] other:

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No.: (41-22) 740.14.35

Authorized officer
Marie-Thérèse Priser

Telephone No.: (41-22) 338.83.38

PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

To:

Commissioner
US Department of Commerce
United States Patent and Trademark
Office, PCT
2011 South Clark Place Room
CP2/5C24
Arlington, VA 22202
ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 23 April 2001 (23.04.01)	
International application No. PCT/NO00/00260	**Applicant's or agent's file reference** E15110 Re/AN
International filing date (day/month/year) 09 August 2000 (09.08.00)	**Priority date** (day/month/year) 10 August 1999 (10.08.99)
Applicant EILERTSEN, Bjørn	

1. The designated Office is hereby notified of its election made:

[X] in the demand filed with the International Preliminary Examining Authority on:

20 February 2001 (20.02.01)

[ ] in a notice effecting later election filed with the International Bureau on:

2. The election [X] was

[ ] was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO **34, chemin des Colombettes** **1211 Geneva 20, Switzerland**	Authorized officer Claudio Borton
Facsimile No.: (41-22) 740.14.35	Telephone No.: (41-22) 338.83.38

(12) INTERNATIONAL . CATION PUBLISHED UNDER THE PATE OPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
15 February 2001 (15.02.2001)

PCT

(10) International Publication Number
WO 01/11261 A2

(51) International Patent Classification[7]: F16H

(21) International Application Number: PCT/NO00/00260

(22) International Filing Date: 9 August 2000 (09.08.2000)

(25) Filing Language: Norwegian

(26) Publication Language: English

(30) Priority Data:
19993835 10 August 1999 (10.08.1999) NO

(71) Applicant *(for all designated States except US)*: **ENGINEERING & DRILLING MACHINERY AS** [NO/NO]; Maskinveien 12, N-4033 Stavanger (NO).

(72) Inventor; and

(75) Inventor/Applicant *(for US only)*: **EILERTSEN, Bjørn** [NO/NO]; Hundvåg Ring 11, N-4085 Hundvåg (NO).

(74) Agent: **REISTAD, Gunnar, O.**; Bryns Patentkontor A/S, P.O. Box 765, Sentrum, N-0106 Oslo (NO).

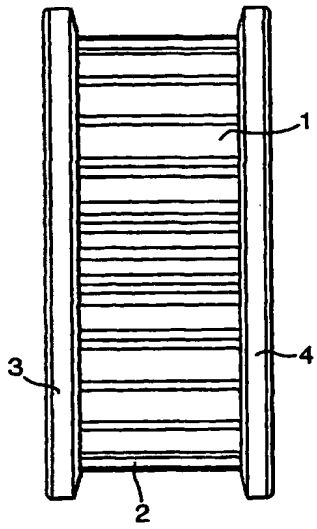
(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published:
— *Without international search report and to be republished upon receipt of that report.*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: METHOD FOR STRENGTHENING A GEAR WHEEL, AND A GEAR WHEEL



(57) **Abstract:** A method for strengthening a gear wheel (1) is described. Each tooth (2) is fixed like a theoretical beam between two extreme points in that two strengthening wheels (3, 4), shaped on their respective insides in accordance with the gear wheel teeth (2), are placed around the gear wheel. To achieve a best possible shrink fit, the toothed rim of the gear wheel (1) is envisaged stretched out to a corresponding larger circle, shrink fits being selected for this circle. Similar considerations are made for the ring.

WO 01/11261 A2

METHOD FOR STRENGTHENING A GEAR WHEEL, AND A GEAR WHEEL

The invention relates to a method for strengthening a gear wheel.

The invention also relates to a gear wheel thus strengthened.

Gear wheels in cranes and lifting devices are highly stressed components. Experience has shown that, for example, driving gear wheels in jack-up systems for jack-up offshore platforms, driving gear wheels interacting with vertical toothed racks, have a surprisingly short useful life. Their useful life is notably shorter than that of the interacting toothed racks, which is due to the fact that the gear wheel teeth are quite naturally exposed to a greater number of alternating loads than the teeth of the rack.

Studies have shown that the teeth of driving gear wheels in large structures are exposed to motions that ultimately cause fracture in the root of the tooth.

It is an object of the invention to provide a method and an apparatus for strengthening gear wheels, particularly, but not exclusively, large driving gear wheels that are used in cranes and lifting devices.

Based on the acknowledgement of the fact that the teeth are subject to breakage as a consequence of the alternating motions in the tooth itself, most notably in the roots of the teeth, it is proposed according to the invention to fix each individual tooth in the gear wheel in the direction of circumference in order thereby to counteract the said tooth motions during operations, i.e., that each individual tooth will be like a theoretical beam fixed at both ends.

According to the invention, a method is therefore proposed for strengthening a gear wheel, characterised in that each tooth is fixed like a theoretical beam between two extreme points, in that two strengthening rings, each shaped on its inside in conformity with the gear wheel teeth, are placed around the gear wheel.

It is especially advantageous if the rings are secured around the gear wheel in such manner that the rings will be firmly shrunk onto the gear wheel with a material-technical tensile/compressive strength within 80% of the 0.2% elastic elongation range of the material (steel).

According to the invention, a gear wheel is also proposed that is characterised in that each tooth is fixed like a theoretical beam between two extreme points, in that around each gear wheel there are fixed two strengthening rings, each shaped on its inside in conformity with the gear wheel teeth.

It is especially advantageous if the strengthening rings are shrunk on in such manner that the rings will remain firmly shrunk onto the gear wheel with a material-technical tensile/compressive strength within 80% of the 0.2% elastic elongation range of the material (steel).

Each individual strengthening ring is designed in principle like an internal ring gear having teeth intended for engagement in the tooth pockets of the gear wheel, with clearance towards the base of the teeth of the gear wheel or clearance towards the base of the teeth of both gear wheel and ring.

The invention can be carried out in a particularly advantageous way by envisaging the toothed rim of the driving gear stretched out to a correspondingly larger circle, shrink fits being chosen for this circle in accordance with the ISO tables of limits and fits, and by making similar considerations for the ring.

The invention will now be described in more detail with reference to the drawing, wherein:

Fig. 1 shows a gear wheel viewed looking towards the teeth;

Fig. 2 is a side view of a gear wheel;

Fig. 3 is a section taken from Fig. 1;

Fig. 4 is a section taken from Fig. 2;

Fig. 5 is a section of a gear wheel and ring in the area where they are secured together; and

Fig. 6 is another section of a gear wheel and ring in an area where they are secured together.

The gear wheel 1 shown in Figs. 1 and 2 has a plurality of teeth 2 around its circumference. At each end side of the gear wheel 1 there is shrink-fitted a strengthening ring 3 and 4 respectively. Each ring 3, 4 is made in the form of an internal gear wheel with teeth 5. The teeth are shaped to fit with the teeth 2 on the gear wheel 1, see in particular Fig. 4.

As can be seen from Fig. 1 and from the section in Fig. 3, each tooth 2 on the gear wheel 1 will be fixed like a beam between the two strengthening rings 3 and 4, and the rings 3, 4 will counteract motions of each individual tooth 2 in the direction of circumference when the teeth are subjected to forces in interaction with another set of teeth on a gear wheel or a toothed rack (not shown).

As shown in Fig. 4, a clearance 6, 7 is provided between the tooth crest and the tooth base on/in the gear wheel and ring. This ensures a best possible flank contact between the teeth 2 and 5 as well as a reduction in the stress of radial forces, see also Figs. 5 and 6. In Fig. 6 there is a clearance 8 only between ring-tooth crest and ring-tooth base.

In order to achieve the best possible effect, each individual strengthening ring 3, 4 is fitted on/around the gear wheel 1 by producing/utilising a tensile force within 80% of the permanent elongation limit of the material (steel). This is achieved by suitable sizing of each individual ring prior to fitting.

It is particularly expedient if, in this connection, it is possible to envisage the toothed rim stretched out to its correspondingly larger circle, shrink fits for this circle being selected in accordance with the ISO tables of limits and fits. Similar considerations are made for the strengthening rings.

The invention permits a reduction in the danger of fatigue fractures without the need to increase the size, and consequently the material consumption.

Patent claims

1.
A method for strengthening a gear wheel (1), characterised in that each tooth (2) is fixed like a theoretical beam between two extreme points in that two strengthening wheels (3, 4), each shaped on its inside in conformity with the gear wheel teeth (2), are placed around the gear wheel.

2.
A method according to claim 1, characterised in that the strengthening rings (3, 4) are secured around the gear wheel (1) in such manner that the strengthening rings (3, 4) will be firmly shrunk onto the gear wheel (1) with a material-technical tensile/compressive strength within 80% of the 0.2% elastic elongation range of the material (steel).

3.
A method according to claim 2, characterised in that during the sizing process the toothed rim of the driving gear (1) is envisaged stretched out to a correspondingly larger circle, shrink fits being selected for this circle in accordance with the ISO tables of limits and fits, and that similar considerations are made for each strengthening ring (3, 4).

4.
A gear wheel (1), characterised in that each tooth (2) is fixed like a theoretical beam between two extreme points in that two strengthening rings (3, 4), shaped on their insides in conformity with the gear wheel teeth (2), are fitted around the gear wheel.

5.
A gear wheel according to claim 4, characterised in that the strengthening rings (3, 4) are shrink-fitted in such manner that the strengthening rings (3, 4) will be firmly shrunk onto the gear wheel (1) with a material-technical tensile/compressive strength within 80% of the 0.2% elastic elongation range of the material (steel).

Fig.1.

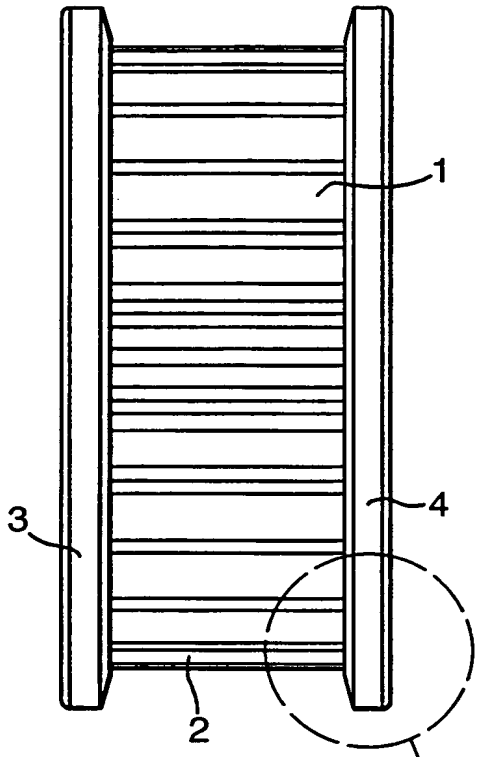


Fig.3.

Fig.2.

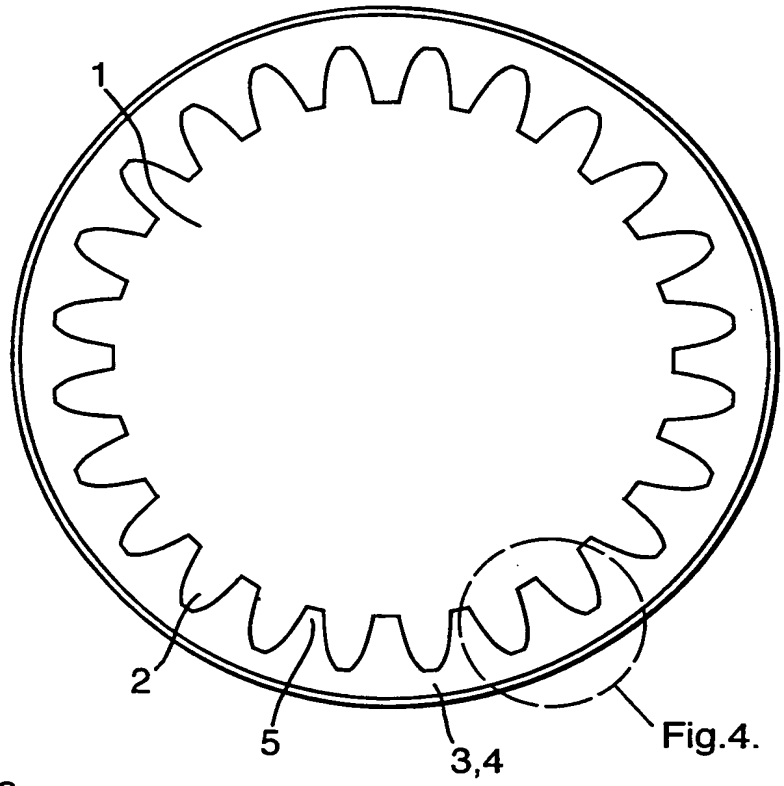


Fig.4.

Fig.3.

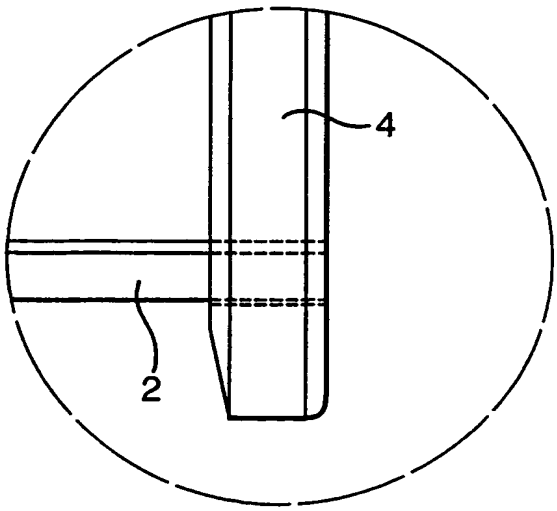


Fig.4.

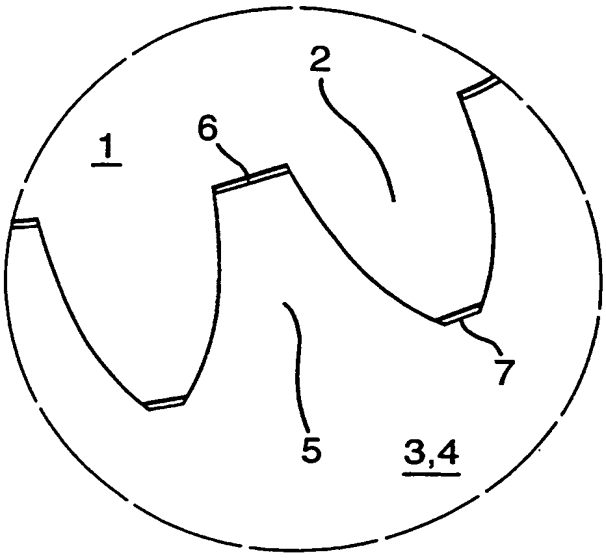


Fig.5.

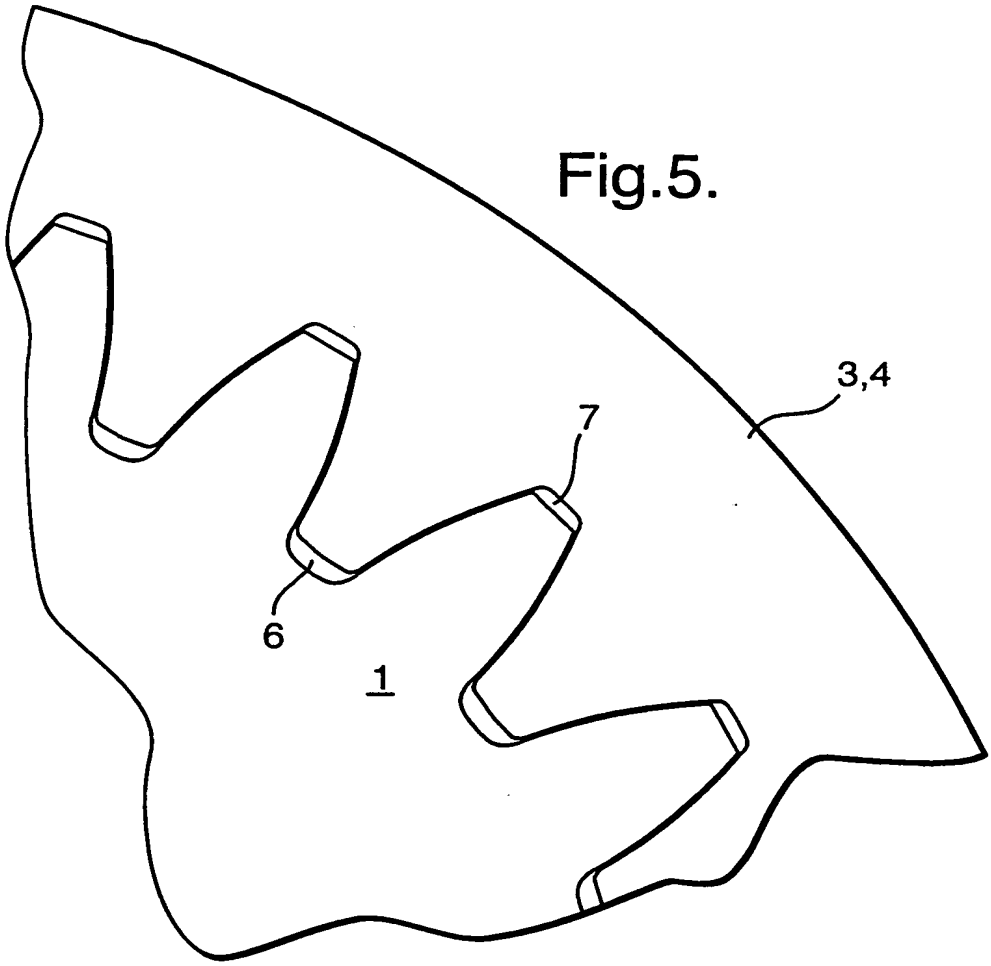
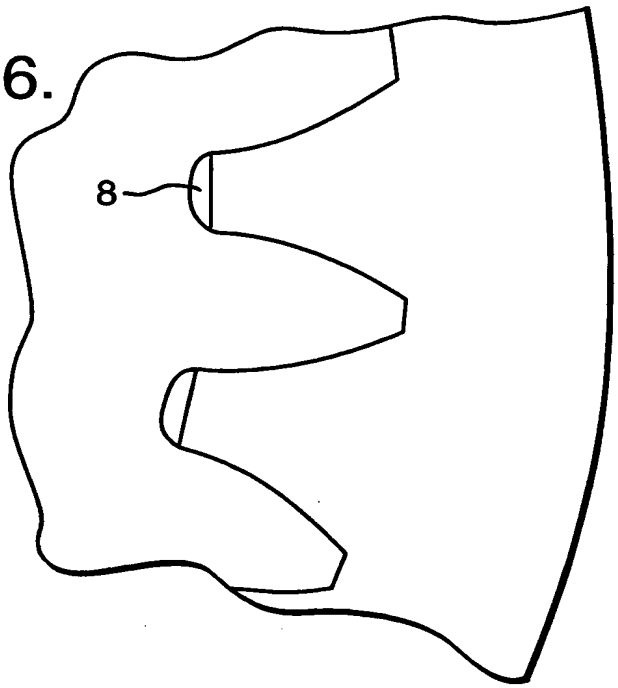


Fig.6.



(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*

[Continued on next page]

(54) Title: METHOD FOR STRENGTHENING A GEAR WHEEL, AND A GEAR WHEEL

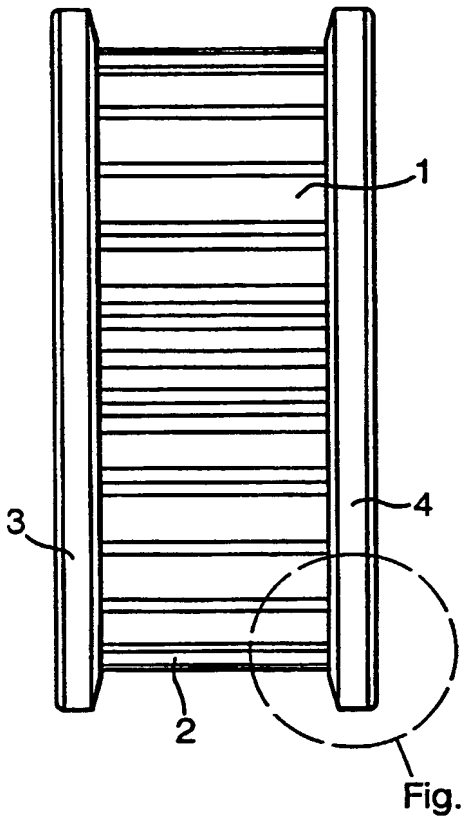

Fig.3.

(57) Abstract: A method for strengthening a gear wheel (1) is described. Each tooth (2) is fixed like a theoretical beam between two extreme points in that two strengthening wheels (3, 4), shaped on their respective insides in accordance with the gear wheel teeth (2), are placed around the gear wheel. To achieve a best possible shrink fit, the toothed rim of the gear wheel (1) is envisaged stretched out to a corresponding larger circle, shrink fits being selected for this circle. Similar considerations are made for the ring.

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(88) Date of publication of the international search report:
20 September 2001

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NO 00/00260

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: B23P 15/14
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: B23F, B23P, F16H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPODOC, WPI

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 3831627 A1 (BURSIG, ERNEST), 22 March 1990 (22.03.90), figure 1, abstract ---	1,4
A	DE 19737111 A1 (ASEA ABROWN BOVERI AG), 4 March 1999 (04.03.99), figures 1,3, abstract --- --------	1-5

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
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Date of the actual completion of the international search	Date of mailing of the international search report
10 November 2000	20 -11- 2000
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Katarina Ekman/MP Telephone No. +46 8 782 25 00

Form PCT/ISA/210 (second sheet) (July 1998)

DE	3831627	A1	22/03/90	NONE
DE	19737111	A1	04/03/99	NONE

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2000 -08- 09

PCT/NO00/00260

PCT

REQUEST

The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty.

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PCT/NO 00/00260
International Application No.

09 AUG. 2000 (09.08.00)
International Filing Date

PATENTSTYRET
Styret for det industrielle rettsvern
▶ PCT International application
Name of receiving Office and "PCT International Application"

Applicant's or agent's file reference *(if desired) (12 characters maximum)* E15110 Re/AN

Box No. I TITLE OF INVENTION

METHOD FOR REINFORCING A COG WHEEL, AND A COG WHEEL

Box No. II APPLICANT

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

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☐ This person is also inventor.

Telephone No.

Facsimile No.

Teleprinter No.

State *(that is, country)* of nationality: NORWAY

State *(that is, country)* of residence: NORWAY

This person is applicant for the purposes of: ☐ all designated States ☒ all designated States except the United States of America ☐ the United States of America only ☐ the States indicated in the Supplemental Box

Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

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Hundvåg Ring 11
N-4085 HUNDVÅG, NORWAY

This person is:
☐ applicant only
☒ applicant and inventor
☐ inventor only *(If this check-box is marked, do not fill in below.)*

State *(that is, country)* of nationality: NORWAY

State *(that is, country)* of residence: NORWAY

This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☒ the United States of America only ☐ the States indicated in the Supplemental Box

☐ Further applicants and/or (further) inventors are indicated on a continuation sheet.

Box No. IV AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE

The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as: ☒ agent ☐ common representative

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

REISTAD, Gunnar O.
BRYNS PATENTKONTOR A/S
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Telephone No. 22 91 04 00

Facsimile No. 22 91 05 00

Teleprinter No.

☐ **Address for correspondence:** Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.

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The following designations are hereby made under Rule 4.9(a) *(mark the applicable check-boxes; at least one must be marked)*:

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☒ **AP** **ARIPO Patent:** **GH** Ghana, **GM** Gambia, **KE** Kenya, **LS** Lesotho, **MW** Malawi, **MZ** Mozambique, **SD** Sudan, **SL** Sierra Leone, **SZ** Swaziland, **TZ** United Republic of Tanzania, **UG** Uganda, **ZW** Zimbabwe, and any other State which is a Contracting State of the Harare Protocol and of the PCT

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☒ **OA** **OAPI Patent:** **BF** Burkina Faso, **BJ** Benin, **CF** Central African Republic, **CG** Congo, **CI** Côte d'Ivoire, **CM** Cameroon, **GA** Gabon, **GN** Guinea, **GW** Guinea-Bissau, **ML** Mali, **MR** Mauritania, **NE** Niger, **SN** Senegal, **TD** Chad, **TG** Togo, and any other State which is a member State of OAPI and a Contracting State of the PCT *(if other kind of protection or treatment desired, specify on dotted line)* .....

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PCT/NO 00/00260

Sheet No. 3

Box No. VI PRIORITY CLAIM ☐ Further priority claims are indicated in the Supplemental Box.

Filing date of earlier application (day/month/year)	Number of earlier application	Where earlier application is: national application: country	regional application:* regional Office	international application: receiving Office
item (1) (10.08.99) 10 August 1999	19993835	NORWAY		
item (2)				
item (3)				

☒ The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) *(only if the earlier application was filed with the Office which for the purposes of the present international application is the receiving Office)* identified above as item(s) (1)

** Where the earlier application is an ARIPO application, it is mandatory to indicate in the Supplemental Box at least one country party to the Paris Convention for the Protection of Industrial Property for which that earlier application was filed (Rule 4.10(b)(ii)). See Supplemental Box.*

Box No. VII INTERNATIONAL SEARCHING AUTHORITY

Choice of International Searching Authority (ISA) *(if two or more International Searching Authorities are competent to carry out the international search, indicate the Authority chosen; the two-letter code may be used)* : ISA / SE

Request to use results of earlier search; reference to that search *(if an earlier search has been carried out by or requested from the International Searching Authority)*: Date *(day/month/year)* Number Country *(or regional Office)*

Box No. VIII CHECK LIST; LANGUAGE OF FILING

This international application contains the following **number of sheets**:

request	:	3
description (excluding sequence listing part)	:	3
claims	:	1
abstract	:	1
drawings	:	2
sequence listing part of description	:	
Total number of sheets	:	10

This international application is **accompanied by** the item(s) marked below:

1. ☒ fee calculation sheet
2. ☒ separate signed power of attorney
3. ☐ copy of general power of attorney; reference number, if any:
4. ☐ statement explaining lack of signature
5. ☐ priority document(s) identified in Box No. VI as item(s):
6. ☐ translation of international application into (language):
7. ☐ separate indications concerning deposited microorganism or other biological materia
8. ☐ nucleotide and/or amino acid sequence listing in computer readable form
9. ☒ other *(specify)*: Copy of Official Action

Figure of the drawings which should accompany the abstract: 1

Language of filing of the international application: NORWEGIAN

Box No. IX SIGNATURE OF APPLICANT OR AGENT

Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the request).

Gunnar O. Reistad

Gunnar O. Reistad, patent agent

For receiving Office use only

1. Date of actual receipt of the purported international application: 09 AUG. 2000 (09.08.00)
2. Drawings: ☒ received: ☐ not received:
3. Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application:
4. Date of timely receipt of the required corrections under PCT Article 11(2):
5. International Searching Authority (if two or more are competent): ISA / SE
6. ☐ Transmittal of search copy delayed until search fee is paid.

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Date of receipt of the record copy by the International Bureau: 28 AUG 2000 (28.08.00)

See Notes to the request form

FREMGANGSMÅTE FOR FORSTERKNING AV ET TANNHJUL, OG ET TANNHJUL

Oppfinnelsen vedrører en fremgangsmåte for forsterkning av et tannhjul.

Oppfinnelsen vedrører også et slik forsterket tannhjul.

Tannhjul i kraner og løfteinnretninger er sterkt påkjente komponenter. Erfaring har vist at eksempelvis drivtannhjul i oppjekkingssystemer for jekkbare offshore-plattformer, drivtannhjul som samvirker med vertikale tannstenger, har overraskende kort levetid. Levetiden er merkbart kortere enn for de samvirkende tannstenger, hvilket skyldes at tannhjulstennene naturlig nok utsettes for større antall veksellaster enn tennene i tannstangen.

Undersøkelser viser at tennene i drivtannhjul i større konstruksjoner utsettes for bevegelser som til slutt gir brudd i tannroten.

Det er en hensikt med oppfinnelsen å tilveiebringe en fremgangsmåte og en anordning for forsterkning av tannhjul, særlig, men ikke utelukkende, større drivtannhjul som benyttes i kraner og løfteverk.

Ut fra erkjennelsen av at tennene utsettes for brudd som følge av vekselbevegelsene i selve tannen, mest merkbart i tannrøttene, foreslås det ifølge oppfinnelsen å spenne inn den enkelte tann i tannhjulet i omkretsretningen for derved a motvirke de nevnte tannbevegelser under drift, dvs. at den enkelte tann vil foreligge som en i begge ender teoretisk innspent bjelke.

Ifølge oppfinnelsen foreslås det derfor en fremgangsmåte for forsterkning av et tannhjul, kjennetegnet ved at hver tann innspennes som en teoretisk bjelke mellom to ytterpunkter, ved at det legges to på sin respektive innside i samsvar med tannhjulstennene tilformede forsterkningsringer rundt tannhjulet.

Særlig fordelaktig spennes ringene rundt tannhjulet slik at ringene vil stå fast krympet til tannhjulet med en materialteknisk strekk-/trykkfasthet innen 80 % av materialets (stål) 0,2 % elastiske forlengelsesområde.

Ifølge oppfinnelsen foreslås det også et tannhjul som er kjennetegnet ved at hver tann er

innspent som en teoretisk bjelke mellom to ytterpunkter, ved at det rundt tannhjulet er spent to på sin respektive innside i samsvar med tannhjulstennene tilformede forsterkningsringer.

Særlig fordelaktig er forsterkningsringene påkrympet slik at ringene vil stå fast krympet til tannhjulet med en materialteknisk strekk-/trykkfasthet innen 80 % av materialets (stål) 0,2 % elastiske forlengelsesområde.

Den enkelte forsterkningsring utformes i prinsippet som et innvendig ringtannhjul med tenner beregnet for inngrep i tannlommene på tannhjulet, med klaring mot tannhjulets tannbunner eller klaring mot tannbunnene i bade tannhjul og ring.

Oppfinnelsen kan særlig fordelaktig realiseres ved at man tenker seg drivhjulets tannkrans utfoldet til en tilsvarende større sirkel, idet man for denne sirkel velger krympepasninger i samsvar med ISO-toleransetabellene, og at tilsvarende betraktninger gjennomføres for ringen.

Oppfinnelsen skal nå forklares nærmere under henvisning til tegningen, hvor

Fig. 1 viser et tannhjul sett mot tennene,

fig. 2 viser tannhjulet i sideriss,

fig. 3 viser et utsnitt fra fig. 1,

fig. 4 viser et utsnitt fra fig. 2,

fig. 5 viser et utsnitt av tannhjul og ring i sammenspenningsområdet, og

fig. 6 viser nok et utsnitt av tannhjul og ring i et sammenspenningsområde.

Det i fig. 1 og 2 viste tannhjul 1 har et antall tenner 2 på sin omkrets. Ved hver i endeside av tannhjulet 1 er det påkrympet en forsterkningsring 3 henholdsvis 4. Hver ring 3, 4 er utformet som et innvendig tannhjul med tenner 5. Tennene 5 er utformet i sampassing til tennene 2 på tannhjulet 1, se særlig fig. 4.

Som det vil gå fram av fig. 1 og av utsnittet i fig. 3, vil hver tann 2 på tannhjulet 1 være

innspent som en bjelke mellom de to forsterkningsringer 3 og 4, og ringene 3, 4 vil motvirke bevegelser av den enkelte tann 2 i omkretsretningen når tennene 2 utsettes for krefter i samvirke med en annen tannsats på et tannhjul eller en tannstang (ikke vist).

Som vist i fig. 4 er det sørget for en klaring 6, 7 mellom tanntopp og tannbunn på/i tannhjul og ring. Derved er man sikret et best mulig flankeanlegg mellom tennene 2 og 5 og avstressing av radielle krefter, se også fig. 5 og 6. 1 fig. 6 er det klaring 8 bare 5 mellom ring-tanntopp og tannhjul-tannbunn.

For å oppnå best mulig virkning spennes den enkelte forsterkningsring 3, 4 på/rundt tannhjulet I med tilveiebringelse/utnyttelse av en strekkraft innenfor 80 % av materialets (stål) flytegrense. Dette oppnås ved egnet dimensjonering av den enkelte ring før påsettingen.

Særlig hensiktsmessig kan man i denne forbindelse tenke seg drivhjulets tannkrans utfoldet til dens tilsvarende større sirkel, idet man for denne sirkel velger krympepasninger i samsvar med ISO-toleransetabellen. Tilsvarende betraktninger gjennomføres for forsterkningsringene.

Med oppfinnelsen kan faren for tretthetsbrudd reduseres uten at man behøver å ga opp i dimensjon, med tilhørende større materialforbruk.

P a t e n t k r a v

1.

Fremgangsmåte for forsterkning av et tannhjul (1), k a r a k t e r i s e r t v e d at hver tann (2) innspennes som en teoretisk bjelke mellom to ytterpunkter ved at det legges to på sin respektive innside i samsvar med tannhjulstennene (2) tilformede forsterkningsringer (3, 4) rundt tannhjulet.

2.

Fremgangsmåte ifølge krav 1, k a r a k t e r i s e r t v e d at forsterkningsringene (3,4) spennes rundt tannhjulet (1) slik at forsterkningsringene (3, 4) vil stå fast krympet til tannhjulet (1) med en materialteknisk strekk-/trykkfasthet innen 80 % av materialets (stål) 0,2 % elastiske forlengelsesområde,

3.

Fremgangsmåte ifølge krav 2, k a r a k t e r i s e r t v e d at man ved dimensjoneringen tenker seg drivhjulets (1) tannkrans utfoldet til en tilsvarende større sirkel, idet man for denne sirkel velger krympepasninger i samsvar med ISO-toleransetabellene, og at tilsvarende betraktninger gjennomføres for hver forsterkningsring (3, 4).

4.

Tannhjul (1), k a r a k t e r i s e r t v e d at hver tann (2) er innspent som en teoretisk bjelke mellom to ytterpunkter, ved at det rundt tannhjulet er spent to på sin respektive innside i samsvar med tannhjulstennene (2) tilformede forsterkningsringer (3, 4).

5.

Tannhjul ifølge krav 4, k a r a k t e r i s e r t v e d at forsterkningene (3, 4) er påkrympet slik at forsterkningsringene (3, 4) står fast krympet til tannhjulet (1) med en materialteknisk strekk-/trykkfasthet innen 80 % av materialets (stål) 0,2 % elastiske forlengelsesområde.

Sammendrag

Det beskrives en fremgangsmåte for forsterkning av et tannhjul (1). Hver tann (2) på tannhjulet innspennes som en teoretisk bjelke mellom to ytterpunkter ved at det legges to på sin respektive innside i samsvar med tannhjulstennene (2) tilformede forsterkningsringer (3, 4) rundt tannhjulet. For oppnåelse av best mulig fastkrymping, tenker man seg tannhjulets (1) tannkrans utformet utfoldet til en tilsvarende større sirkel, idet man for denne sirkel velger krympepasninger. Tilsvarende betraktninger gjennomføres for ringen.

Fig. 1.